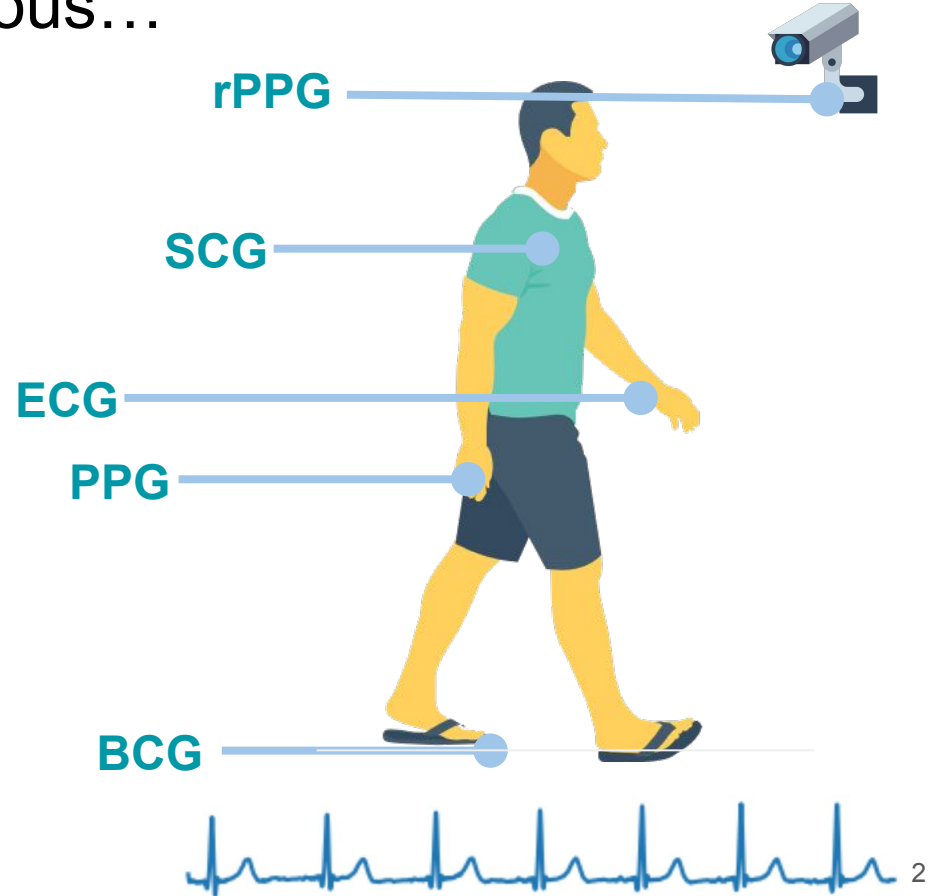


Biosignal Authentication Considered Harmful Today

Veena Krish, Nicola Paoletti, Milad Kozemi,
Scott Smolka, Amir Rahmati



Biosignal collection is ubiquitous...



... and increasingly considered for user authentication

B SECUR
Analog Devices and B-Secur Collaborate on Biometric Technologies for the Automotive Industry

Microsoft and Samsung work on health biometric patent filings
Apr 29, 2021, 8:02 am EDT | [Chris Burt](#)

Authentication
biometric
algorithm
e technology
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PRODUCTS ▾ LOGIN PEOPLE TA

and free yourself from the rhythm of your heart
al world with a new cardiac ec
ned to help you navigate the m
while protecting what matters most

Your identity.

Passbook 10:09
AMERICAN EXPRESS
CHASE freedom VISA
... 9112 VISA
jetBlue

and Nymi say they've made the first heartbeat-enabled mobile payment in the world

RECEIVED

nymiband™

... and increasingly considered for user authentication

B SECUR

Analog Devices and B-Secur Collaborate on Biometric Authentication Technologies for the Automotive Industry

Microsoft and Samsung show work on health biometrics in patent filings

Apr 29, 2021, 8:02 am EDT | [Chris Burt](#)

Develop a complete biometric

Develop a biometric algorithm
essengers. The technology
any irregularities. In

TALIWARE

PRODUCTS ▾ LOGIN PEOPLE TA

Verify and free yourself the rhythm of your heart

Unlock your digital world with a new cardiac eCG algorithm designed to help you navigate the modern world while protecting what matters most.

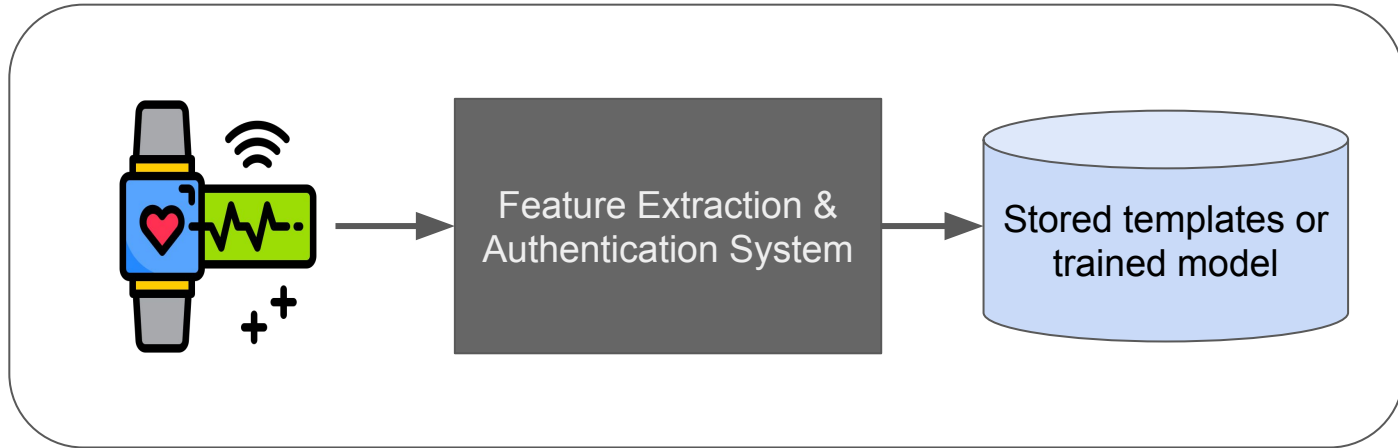
Your identity.

MasterCard and Nymi say they've completed the first heartbeat-authenticated mobile payment in the wild



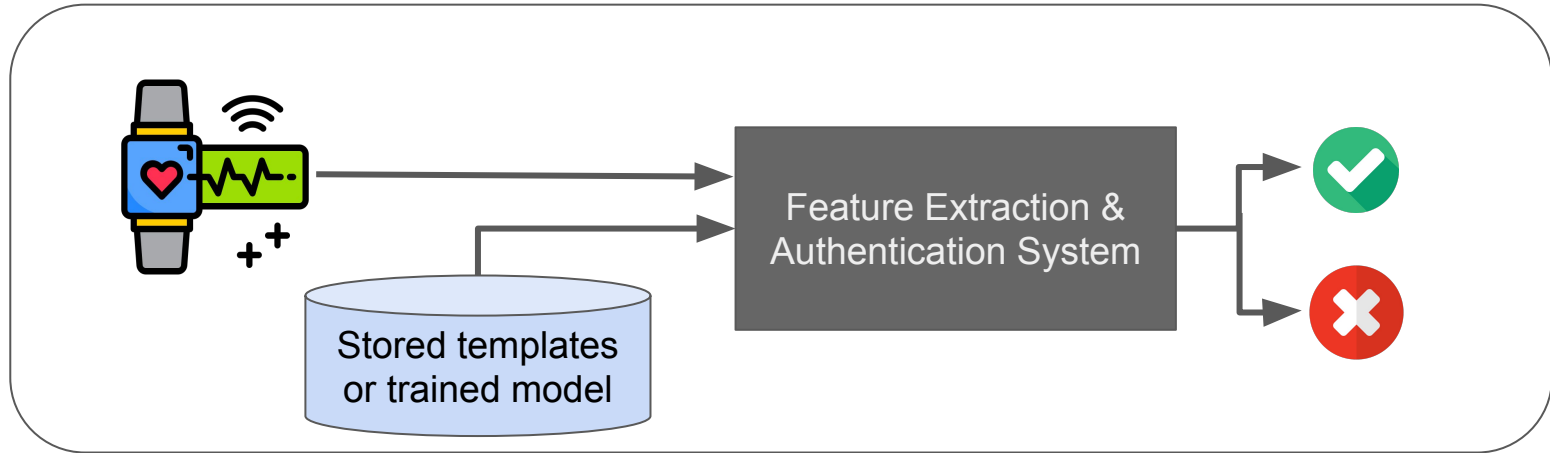
How does this typically work?

Phase 1: Enrollment



How does this typically work?

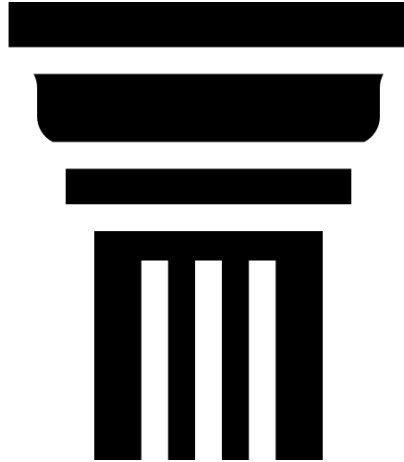
Phase 2: Authentication/Verification



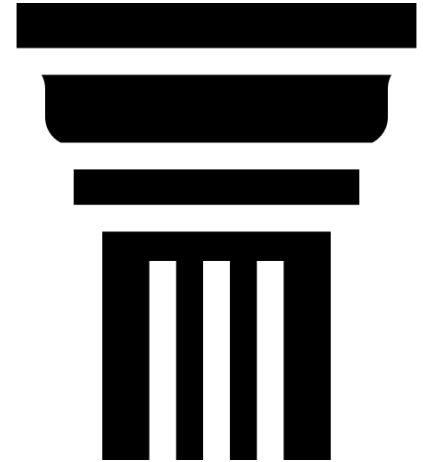
Assumptions behind using biosignal authentication



Features are
consistent



Features are unique
to individuals



Biosignals cannot
be forged

Biosignals cannot be forged? Challenging this assumption



Leaked medical data

Kaiser Permanente notifies 13.4 million members of data breach. City of Hope also reported breach

Fitbit, Apple fitness tracker data exposed on unprotected database

Biosignals cannot be forged? Challenging this assumption



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Compromised wearables

Fitbit Spyware Steals Personal Data via Watch Face



Pacemaker Recall Highlights Security Concerns for Implantable Devices

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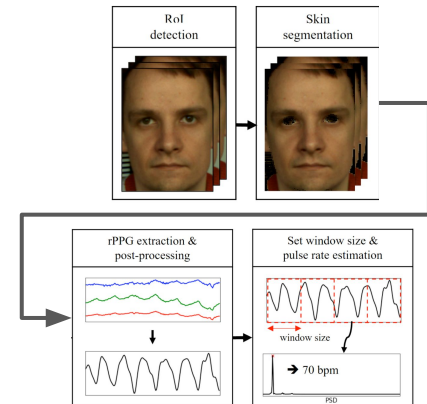
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Extracting signals from video



Yu S-G, *et al.* Pulse Rate Variability Analysis Using Remote Photoplethysmography Signals. *Sensors*. 2021

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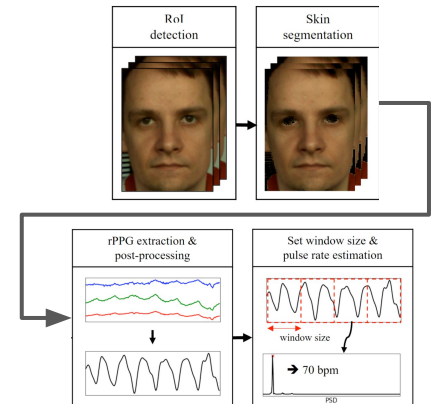
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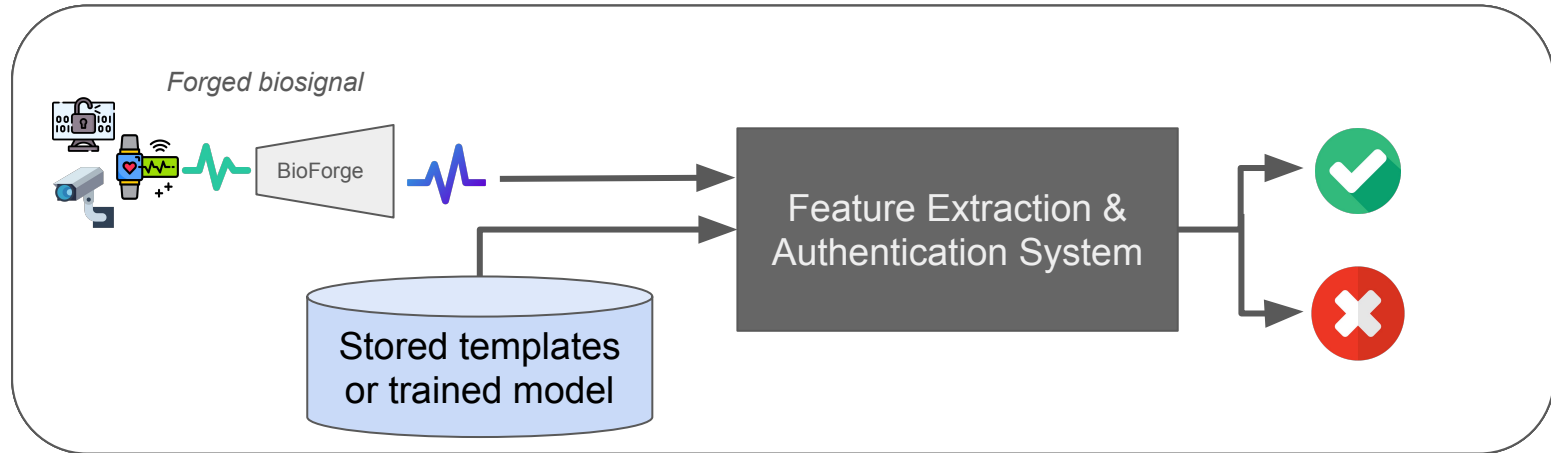
Extracting signals from video



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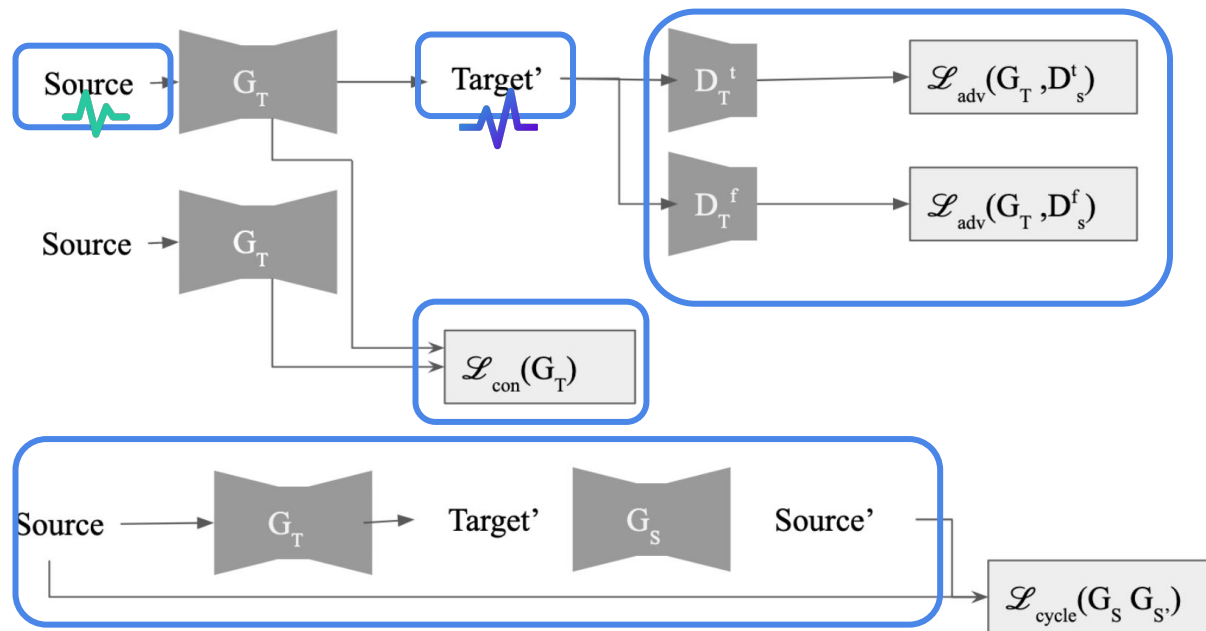
BioForge

An attack on ***all*** cardiovascular biosignal authentication systems using easily-obtained data



BioForge generative model

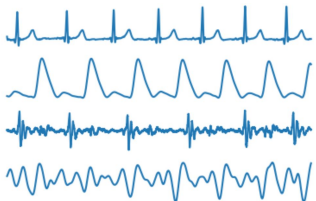
- Cycle-consistent GAN
- Does not required supervised paired data
- Time- and Freq-based discriminators
- Contrastive loss



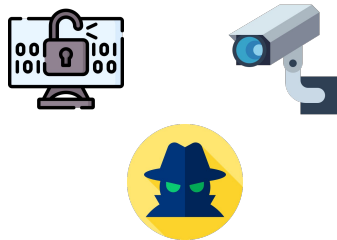
Holistic evaluation

5 classes of signals

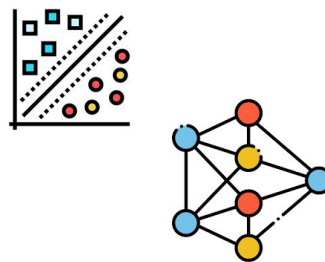
ECG, PPG, rPPG,
SCG, BCG



Varied sources

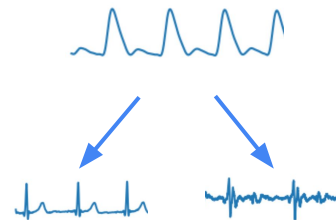


Varied auth system algorithms



Multimodal systems

Multiple targets from
a single source

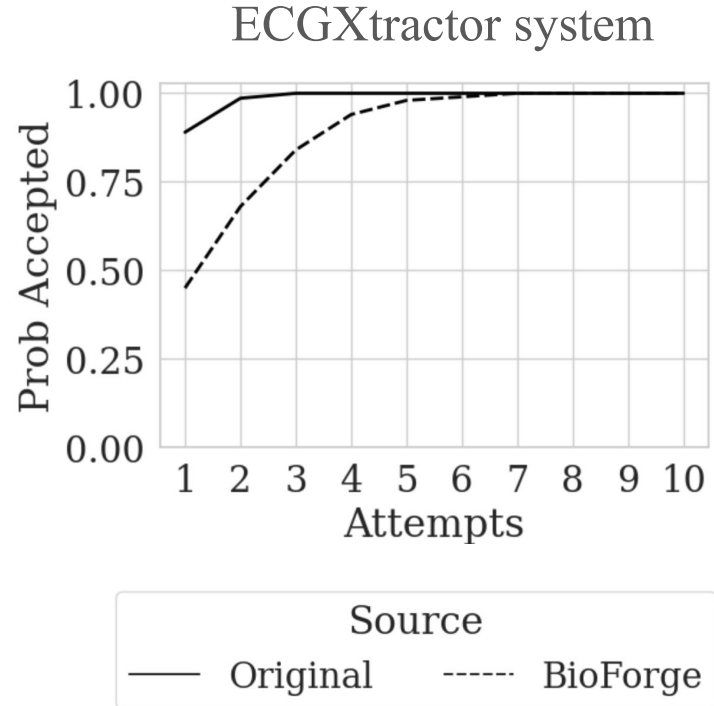


False acceptance likely

Pronounced with repeat attempts

Allowed 10 attempts,
each with a different
source sample

Forged data likely to be
accepted

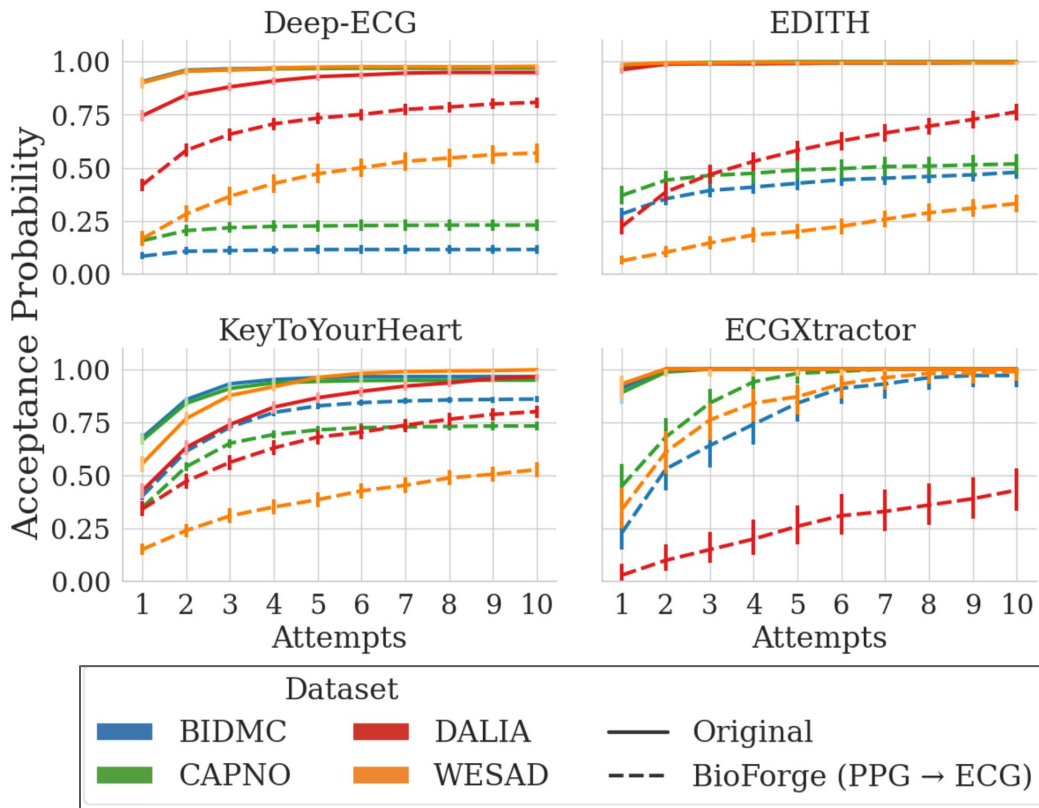


False acceptance likely

Pronounced with repeat attempts

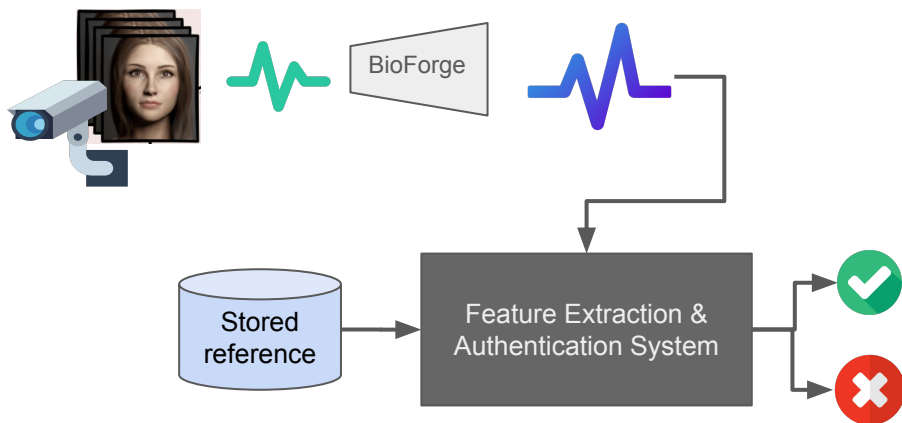
Regardless of the auth system architecture

Consistent across datasets

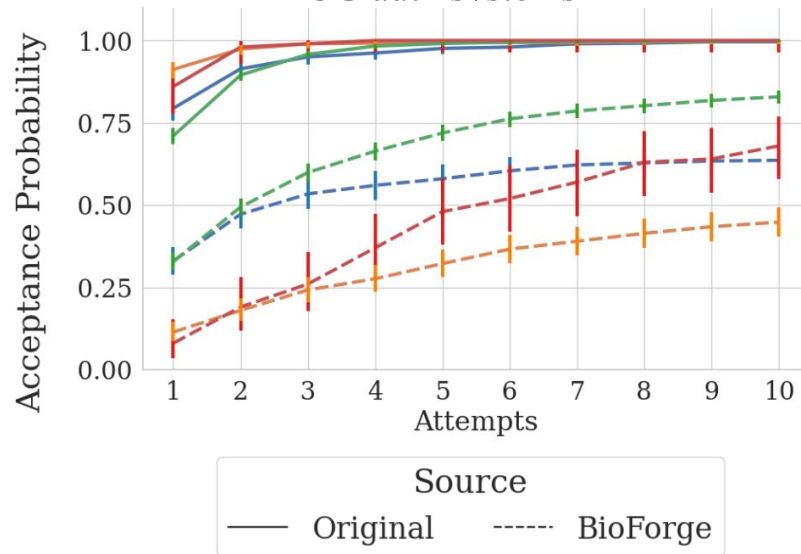


And can be generated from video

Generated forged ECG data
from video clips



Video-source spoofing for different
ECG auth systems



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**Auth systems cannot rely on
secrecy of biosignal data**



github.com/Ethos-lab/biosignal-auth-harmful

kveena@cs.stonybrook.edu